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amount of space. In the case of the latter, many photographs aid in familiarizing the reader with the forms of flowers and foliage. Notes on mammals and birds are almost absent. A single instance of a bird feeding upon lepidoptera was noticed. On the other hand, copious notes were made on the natives, their customs, mode of life, houses and villages. But the matter relating to dragonflies, the discovery of the various forms and the rearing of their larvæ, stand out from all the rest of the text. In dealing with this phase of research, the enthusiasm is distinctly greater, the diction more pleasing, and the treatment more thorough.

The text presents many readable descriptions of scenery and of unexpected conditions in this tropical country. Such a one is the strawberry field with its amazing amount of delicious fruit, shaded by tall rose trees. And the last chapter has a most vivid narrative of a disastrous earthquake in which the whole city of Cartago was ruined and several hundred people killed. The authors fortunately escaped with their notes and photographs. They go on to recount: "The falling wall carried with it the tumbler shelf so that the larvæ, the rearings of many months, were all killed—with one extraordinary exception. A bottle of new *Cora* larvæ which P. brought with him the evening before from Juan Vinas—the rarest thing we had—was found on the floor, unbroken and with the larvæ alive!"

In addition to the well-made index there are several appendices dealing with the itinerary, temperature and rainfall records, a summary of papers published in connection with the collections made on the trip, and a systematic list of plants and animals mentioned. As this latter has the page references, the contents of the volume are thus made still more available for reference. The authors are to be sincerely congratulated on having saved their incidental notes and observations from oblivion. Such work can not fail to add to any breadth of generalizations in their own more narrow field of special, intensive work, and sets a standard for other expeditions which it is hoped will often be equalled or surpassed.

"The Voyage of the Beagle" is bearing late fruit and should be a stimulus to all such effort in the future.

WM. BEEBE

NEW YORK ZOOLOGICAL PARK

SPECIAL ARTICLES

THE EFFECT OF OMNIVOROUS AND VEGETARIAN DIETS ON REPRODUCTION IN THE ALBINO RAT

AN experiment, now in its fifth year, is being carried on to show the effect of a vegetarian diet as compared to an omnivorous diet on reproduction in the albino rat in regard to:

1. The relative number of litters produced.
2. The relative number in the litter.
3. The relative frequency of producing litters.
4. The relative ratio of the sexes.
5. The relative vitality and growth of the young.
6. The relative longevity and general appearance.
7. The relative age at which breeding begins and ceases.
8. The general effect upon successive generations.
9. Sterility test; to determine whether it is the male or the female which is rendered impotent.

The number of pairs constantly under observation was 40. Approximately 20 of these pairs were restricted to a vegetarian diet and the remaining, used for control, were given the same vegetables with some form of animal food added. As soon as one of a pair died the other was remated. Or when they became too old to breed they were discarded and the cage restocked.

The results and conclusions so far reached may be summarized as follows:

If only those pairs which produce litters are taken into consideration the average number of litters per pair for the omnivorous group is 3.73 and for the vegetarian, 1.93. But when the whole group of matings are considered we find that 11.5 per cent. of the omnivorous and 55.9 per cent of the vegetarian pairs failed to reproduce. If these are considered, the average number of litters is

reduced to 3.15 and .89 per pair respectively. This is a ratio of about 3.6 to 1 in favor of the omnivorous feeders.

The greatest number of young born by a single pair is 41 in the omnivorous group and 23 in the vegetarian group. The average number of young for each mating is 15 for the omnivorous feeders and 4 for the vegetarian.

The number of young eaten by the parents is 19.5 per cent. in the omnivorous group and 35.8 per cent. in the vegetarian.

The ratio of sexes in the two groups is 113.6 males to 100 females in the omnivorous young and 107.6 males to 100 females in the vegetarian young.

The average weight (both sexes) of the omnivorous young at birth is 4.59 grams and the vegetarian young is 4 grams. A much heavier weight is maintained by both sexes of the omnivorous rats throughout their lives as shown in the curves of growth. This is shown in the following table. The retardation of growth of the new born vegetarians appears to be due to the decreased lactation of the mothers.

was born was 169 days for the omnivorous and 223 days for the vegetarian rats.

The oldest age at which a litter was born in the omnivorous group was 570 days and in the vegetarian, 600 days. The average ages were 330 and 334 days respectively. The average duration of the period of reproductive activity in the omnivorous group is thus 161 days and in the vegetarian group 111 days. The restricted diet thus appears not only to delay the period of reproductive activity, as other writers have found, but also to actually shorten the duration of this period.

Matings were made to test which sex was the cause of the failure to reproduce. Vegetarian pairs, when they ceased to reproduce, were separated. New healthy omnivorous males were mated to the vegetarian females and new healthy omnivorous females were mated to the vegetarian males. All these new matings failed to reproduce. The conclusion drawn is that a vegetarian diet produces sterility in both sexes.

It has been impossible to determine the effect of a continued vegetarian diet on the

	Avg. No. Litters per Breeding Pairs		Percentage of Non-breeding Pairs	Total Avg. No. Litters	Greatest No. Litters	Greatest No. Born from Single Pair	Avg. No. Born per Pair	Avg. No. in Litters	Avg. Wt. in Grams at Birth	Avg. Wt. in Grams at 30 Days	Avg. Wt. in Grams at 600 Days	Ratio of Sexes of Young	Percentage of Young Eaten by Parents	Youngest Age in Days of Mother at 1st Litter	Avg. Age in Days of Mother at 1st Litter	Oldest Age in Days of Mother at Last Litter	Avg. Age in Days of Mother at Last Litter	Avg. Interval in Days Between Litters
Omnivorous.....	3.7	12%		3.15	9	41	15	4.8	4.59	28.8	208	113♂ to 100♀	19.5%	90	169	570	330	67
Vegetarian.....	1.9	56%		.89	3	23	4	4.5	4.00	15.7	140	107♂ to 100♀	35.8%	119	223	600	334	97

The difference in appearance of the two groups is very marked. The vegetarians are smaller, have less vigor, are less active, have rougher hair and a tendency to sore eyes, while the omnivorous are the reverse in these respects.

The earliest ages at which the first litter was thrown is 90 days for the omnivorous and 119 days for the vegetarian group. Since the period of gestation is 21 days the age of sexual maturity in each of these cases was 59 and 98 days respectively.

The average age at which the first litter

race, as only two or three successive generations have been reared on this diet before the line of descent became extinct. We must therefore conclude that a vegetarian diet not only reduces the vitality, the growth, and the ability to reproduce, but tends to the extermination of the race.

We are expecting to have the complete paper ready for publication in the near future.

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